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ABSTRACT

This paper reports on a pilot study conducted to determine the effectiveness and utility of a computer-assisted drill program in mathematics with disadvantaged seventh graders. The instructional materials used were Suppes' drill and practice lessons. Twenty students were chosen to participate in the study for a two-month period. At the completion of the program each student was interviewed and given a written questionnaire to complete. Pretest scores were used to assign students to certain "concept blocks." Each student was then branched to one of five levels based on their performance on a non-standardized internal pretest. Teachers received daily analyses of each student's work and each student received a print-out of the day's lesson. Concepts studied by the students ranged from addition and subtraction of whole numbers to addition, subtraction, multiplication, and division of fractions and decimals. Results of an analysis of available data indicated that although students achieved significant gains when measured by an internal test directly related to the instructional content, they did not achieve significantly more as measured by scores on the Wide Range Achievement Test. There seemed to be evidence that the students' interest in mathematics increased and the programed materials did seem to be appropriate in terms of level of difficulty and reading. (FL)

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USE OF COMPUTER ASSISTED INSTRUCTION IN MATHEMATICS FOR DISADVANTAGED SEVENTH GRADE YOUTH

By

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Recent studies by Belin and Gotkin (1964), Moriber (1962), and Mendelssohn (1968), have indicated that the mathematical needs of disadvantaged students are not being met in the schools today. The purpose of this study is to report on a pilot study involving the use of computer-assisted instruction as a supplementary aid in a class using programmed learning materials for seventh-grade disadvantaged youth.

Programmed learning materials and individualized instructional materials are helpful for disadvantaged youth because of the youths' unusually wide range of skill and achievement in mathematics at the junior high school level. Demands of diagnosis, planning, implementation, and evaluation of programmed and individualized instructional materials are often insurmountable for the teacher working with many students on different levels. Briggs and Angell (1964), and May (1965) suggest that computer-based learning is one of the most promising programmed instructional techniques for the teaching of mathematics. Schurdak (1967) suggested the following application of the computer to education: (a) it can be used as a device for achieving individualization of instruction based on each student's performance and ability; (b) it can be used as a device for providing immediate item-by-item evaluative feedback to each student and teacher; (c) it can be used as a device for identifying erroneous conceptions, and preventing new material from being presented until the student demonstrates a thorough and

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accurate understanding of the present material.

Bloom (1968) suggested achievement mastery learning for raising the level of pupil performance. The techniques that seemed to be most valuable were: (1) the opportunity of the child to achieve mastery of a set of objectives even if he did not succeed the first or second time, (2) the emphasis placed by the teacher on the pupil's gaining the prerequisite knowledge before proceeding to a task that requires mastery of that knowledge, and (3) the extra help sessions conducted for those who did not sufficiently attain the objective.

Because of the developments by Suppes, et al, (1966) Computer-Assisted Instruction Drill and Practice Mathematics Program at Stanford University, by Bitzer's (1967) Programmed Logic for Automated Teaching Operations at the University of Illinois, and Quinn's (1968) Research at IBM Watson Center, it seemed fitting and proper that this pilot study should be conducted to determine the effectiveness and utility of a computer-assisted supplementary drill program with the disadvantaged seventh-grade pupils already using programmed materials.

The Study

Subjects:

Seventh-grade students involved in this pilot study attended a 95 percent Black junior high school in the Los Angeles City School District. The school had a Mathematics Demonstration Resource Center financed by State of California funds. The emphasis of this "Center" was the use of an integrated approach consisting of printed individualized programmed instructional materials and manipulative devices for the teaching of eighty underachieving culturally disadvantaged Brown and Black students. Academic achievement

of the students was assessed using the Iowa Test of Basic Skills and The Wide Range Achievement Test. Based on the prior test results, the daily performance of students, and the recommendations of the teachers from the center, twenty students (nine boys and eleven girls) were selected from the eighty students to participate in the supplementary session using the computer-assisted instruction for a two-month period during the academic year 1968-1969. At the completion of the program, each student was interviewed and given a written questionnaire to complete. The purpose of the questionnaire was to determine the students' satisfaction or dissatisfaction with the computer instruction.

Procedure:

The instructional materials used for the computer-assisted instruction sessions were the drill and practice lessons written by Patrick Suppes of Stanford University. Students received the lessons for ten minutes a day on a teletypewriter terminal located at the center. The terminal was connected by telephone to a computer located at the Stanford Computation Center. Students were scheduled by the teachers in such a way so that each student used the teletypewriter at least once a day for a ten-minute period during the two-hour connection period with Stanford Computation Center.

Test scores (ITBS and WRAT) were used by Stanford Computation Center to place each student in a class and to program the student to receive drill and practice lessons containing certain "concept blocks". After being programmed into a "class" and a concept block, the student's first work at the teletypewriter consisted of a non-standardized internal pretest. The test items were displayed on the terminal and scoring was indicated both on the students' printouts and on the Concept Block Progress Report given to the

teacher. The computer then branched the student to one of the five levels based on the student's performance. Students who scored between 60 and 79 percent were given a new lesson on the same level the following day. Students who scored above 70 percent were given a lesson on the next higher level. Students who failed to score at least 60 percent were given a simpler lesson on a lower level.

Each lesson within a concept block contained five levels of difficulty. Twenty students were grouped into three "classes," grades 3, 5, and 6. One student was placed in grade 2. After the student had completed a concept block, the machine administered a posttest. The results of this posttest were used by the computer in selecting review material for the student. Thus the computer provided highly individualized review and practice lessons on basic concepts and skills.

The teachers received daily analyses of each student's work. Each student received a print-out of the day's lesson. The analysis and the copy of the student's print-out provided teachers with information to assist the teacher in planning appropriate materials for the students. Manipulative materials were used whenever possible to aid in the concept building.

The concepts studied by the students for grades 2, 3, 5, and 6 included the following:

2nd Grade

Subtraction, horizontal and vertical format

3rd Grade

Mixed drill of whole number, fractions, addition, subtraction, and reducing to lowest terms

Multiplication of 1 and 2 digit numbers

Addition and subtraction of whole numbers (easy)

Addition and subtraction of whole numbers (harder)

5th Grade

Mixed drill, addition and subtraction

Multiplication of 2 and 3 digit numbers

Fractions, addition, subtraction, reducing to lowest terms

Division, finding partial quotients only

Mixed drill, including fractions and decimals

6th Grade

Mixed drill of whole numbers

Fractions, addition, subtraction, multiplication, and division

Division, finding partial quotients only

Mixed drill, including fractions and decimals

Mixed drill, including fractions, division, percent

A teacher consultant acted as an observer of the student's reaction to the teletypewriter. Personnel were available to assist the student in case of mechanical difficulties between the computer and the teletypewriter.

At the completion of the program the students were given a questionnaire to complete. The items of the questionnaire included the following:

1. Which way of doing arithmetic drill helps you most? (Check one)

   Chalkboard_____Computer_____Textbook_____Workbook_____

   Overhead Projector_____Other_____

2. Which way of doing arithmetic drill do you like best? (Check one)

   Same choices as in No. 1.

3. What did you like best about doing arithmetic drill on the computer?

4. I would like to use the computer better if_____...

5. Working on the computer has made my arithmetic class_____...

6. The problems on the computer were_____...

7. Reading the directions given by the computer was_____...

8. The "time is up" messages_____...

9. Getting the answers to questions I missed_____...

10. Getting the results of my work right away_____...

11. Would you like to work on the computer next semester if it remained in your school?

yes_____ no_____

Why?_____...

The responses from the questionnaire were tabulated and summarized. Significant trends in these responses are indicated below.

When asked if they (students) would like to continue working on the computer, all of the responding students indicated an affirmative answer. Responses to the open-end item which asked students their reasons for wishing to continue on the computer were summarized into the following categories:

Response	Frequency*
It helped me understand math better.	8
I liked it.	7
It's better than other methods.	2
It's fast.	1
It made me study more.	1
It's an easy way to learn.	1
It helped me know what I missed.	1

*duplicated count

Students offered the following types of responses to an open-end item when asked what they liked best about doing arithmetic drill on the computer:

Response	Frequency*
It helped me understand better.	6
It's faster than writing.	5
I liked the fractions.	4
It gives the answer when you're wrong.	2

*duplicated count

Students indicated that they would have been more satisfied with the computer if the response time between problems had been greater than ten seconds.

Discussion

Using an internal test, administered at the terminal, the posttest scores were found to be higher than the pretest scores and the difference was significant at the 0.01 level of confidence. The Concept Blocks completed by individual students in the program appear in Table 1 on the next page. The most significant gains were made by those students in grades 2 and 6. In the table that follows the reader should recall that the starting point for each student was determined by the computer pretest, and the option to move to the next concept block was granted only upon the student's demonstration of adequate comprehension of the preceding concept block(s). Details of the pretest and posttest administered within the program can be found in Suppes, et al, (1965). Using the standardized achievement test a comparison of the pretest and posttest scores of the students revealed no significant gain by the students at the end of the two-month period.

Conclusions and Recommendations

Based upon the data gathered from the testing procedures and the written questionnaire administered to the students at the completion of the program, the following conclusions were drawn:

1. Students in the pilot study did achieve significant gains when measured by an internal test directly related to the instructional content of the programmed materials.

2. Students in the pilot study did not achieve significantly more during the two-month period as indicated by the scores on the Wide Range Achievement Test. However, on the average the students attempted to answer at least five more problems than they did on the pretest, thus indicating a higher degree of motivation.

3. The students' interest in mathematics was increased as a result of their work on the computer, as evidenced by their statements in interviews held at the completion of the study.

4. Programmed instructional content was generally suitable in terms of the level of difficulty and of the level of reading.

5. Assigned hours of 7 a.m. to 9 a.m. were not desirable in terms of consistent student attendance for greater than a two-month period.

In conclusion, children learn by doing and thinking about what they do. Innovative education must provide the student with opportunities to use technology to discover things for themselves. The use of computer assisted instruction is a meaningful helper and assistant for the teacher in directing learning experiences for students.

TABLE I

Level of Material Covered
At Termination of Program

Student Number	Grade Level of Material	Concept Blocks Completed			
101	2	Addition	Subtraction	Addition and Subtraction	
		Addition, Subtraction, and Multiplication	Fractions	Multiplication	
102	3				
103	3				
		Addition and Subtraction	Multiplication	Fractions	Division
104	5				
105	5				
106	5				
107	5				
108	5				
109	5				
110	5				
111	5				
112	5				
113	5				
		Addition, Subtraction, and Multiplication	Fractions	Division	Mixed Drill
114	6				
115	6				
116	6				
117	6				
118	6				
119	6				

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